Plastics and NANO plastics at 5th Chemicals Conference (ICCM5)

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The *5th International Conference on Chemicals Management* (ICCM5) organized by the United Nations Environment Programme (UNEP) will be held from September 25 to 29, 2023. There, the progress of the Strategic Approach to International Chemicals Management (SAICM, n. d.) will be reviewed. Nanotechnologies and their products have been one of the topics of SAICM since 2009.

In that conference, and within the chapter on nanotechnologies, a report on the contamination of the marine environment by micro and nanoplastics will be discussed (GESAMP, 2016). The World Health Organization (WHO) and UNEP refer to plastic pollution as a "global pandemic" since the beginning of this century (Kemf & UNEP, 2013). Twenty years later, in 2022, the UN is implementing a new agreement on plastic pollution (like the Climate Change treaty) that aims to draft an international treaty to regulate plastics throughout their life cycle. The WHO issued a note of support for UN regulation of plastics, the draft of which should be due before the end of 2023 (WHO, 2023). But what are nanoplastics and what is their importance in the international discussion? Nanotechnology is the manipulation of matter in nanometer size with the purpose of creating new functionalities to nanoparticles and associated structures. This occurs because at the nanometer level (thousands of times smaller than a cell) known materials develop unknown properties that can be very useful or toxic (some nanomaterials penetrate cells and damage DNA). Nature also produces nanoparticles. Thus, nanoparticles of natural origin coexist with nanoparticles of human origin in the environment. In any case, alongside large plastic waste, there are microplastics and tiny plastics in the environment that are imperceptible to the eye: nanoplastics.[1]

Since the beginning of this century, when some regulatory agencies have been seeking to regulate nanotechnologies, there is no agreement on how to define nanoparticles. It is argued that it should be by the novel function, but it is also said that it should be by size, or both at the same time. Opinions also vary on size, some say up to 1000 nanometers (1 micrometer), others say up to only 100 nm; the disagreement is due to the

[1] During the Covid pandemic billions of face masks ended up in the environment releasing toxic nanoparticles as a result of degradation (Sarp, 2021).

fact that, depending on the material, its constitution, shape, size, etc., functionality may vary. Function and size are dynamically interrelated.

The GESAMP paper to be discussed at ICCM5 is on nanoplastics in the marine environment. But nanoplastics of natural or human origin? And why is the paper ambiguous as to whether they are micro or nanoplastics? The answer to these questions is of great importance to understand the politics behind science.

Nanoplastics in the marine environment reach that size as a result of the natural forces of erosion of larger plastics, including microplastics. In this sense they are naturally produced. But plastics are all human products and, from this other perspective, nanoplastics are humanly produced and naturally pulverized and dispersed. Whether they are a human or natural result is key to regulation because there are many nanoparticles in the environment of natural origin, such as those emitted by volcanoes, and no one would think of regulating them ...

The second question is not just a terminological difference, micro or nano, the health and environmental effects are different for nanoplastics and microplastics! From a meta-analysis of more than 600 scientific articles, most of them conclude that nanoparticles (nanoplastics) are more toxic than micro and greater particles (Pelegrini et al., 2023). In the marine environment nanoplastics migrate and disperse differently than microplastics (Shi et al., 2023); and the spontaneous and dynamic process of nature causes new aggregations of nanoplastics and disaggregation, altering the toxicity, reactivity, fate within living organisms, ease of transport in water and risk to the environment and organisms (ter Halle & Ghiglione, 2021). But, as there is no consensus definition on size, the answer can only be ambiguous and uncertain (Gigault et al., 2018).

We now turn to the public policy behind science. Since the beginning of this century, nanotechnology regulatory agencies have been arguing that the scientific processes and methodologies for evaluating new chemicals brought to market, including nanomaterials are sufficient and appropriate for evaluating the nanochemicals produced. Simultaneously, although it is a paradox, the same regulatory agencies recognize that nanochemicals have different behaviors than macrochemicals, including different toxicological functions. Does it make sense that they are recognized as different and regulated as the same? The paradox is explained because science depends on the economic and political interests of its actors, and chemical corporations pressure politicians not to ban or to delay the entry into the market of new potentially toxic chemicals, because they produce huge profits. That is why large chemical corporations support laboratory analysis that hides the paradox between new beneficial function and eventual toxicity. When internationally registered laboratories for regulatory purposes, including some corporate ones, analyze new nanochemicals they use equipment, research protocols, methodologies, indicators, and variables that do not detect the specifically nano issues. This science is vaunted as "sound".[2]

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[2] Bradford and colleagues (2022) review several papers on new genomic techniques and nanoparticle-derived effects in the environment, noting that " ... studies are conducted under highly ideal conditions ..."

The politics behind the science is also in the methodological approach. Risk assessments or risk analysis, which are the procedures used to analyze the potential risk of new chemicals being brought to market, is reductionist. It is reductionist because it only analyzes the material itself, i.e., whether the material can cause diseases, alter organic functions, etc., but it does not analyze what happens when that material is released onto the market. It does not analyze what happens when that material encounters other chemicals in the environment or inside living organisms. It reduces the analysis to the most immediate and known, “the long-term behaviour of plastics in the marine environment is essentially unknown” (GESAMP, 2016, p.18) . The unknown is of no interest to hegemonic or “normal” science (Kuhn, 2012). The problem with nanoplastics in the marine environment is that they are very difficult to identify, assess, and regulate. The GESAMP paper says: “However, nanoplastics have not been detected as yet in the marine environment (mainly due to the logistics challenges in analytical procedures) and the range of marine organisms exposed to them are unknown (GESAMP, 2016, p.19).

For normal science what cannot be investigated "does not exist". Another philosophical approach suggests that it is necessary for science to incorporate uncertainties and gaps in knowledge, known as "post-normal" science (Ravetz, 2004), and its strongest science and technology policy instrument is the Precautionary Principle that chemical corporations strongly fight against.

ICCM5 will probably end up selecting some plastics that tend to become micro and nano detritus in the marine environment to reduce or eliminate their production in a few years, leaving the door open for chemical corporations to continue producing many others, and to slightly change the composition of banned or restricted plastics to escape regulation. It will be another triumph of normal science.

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